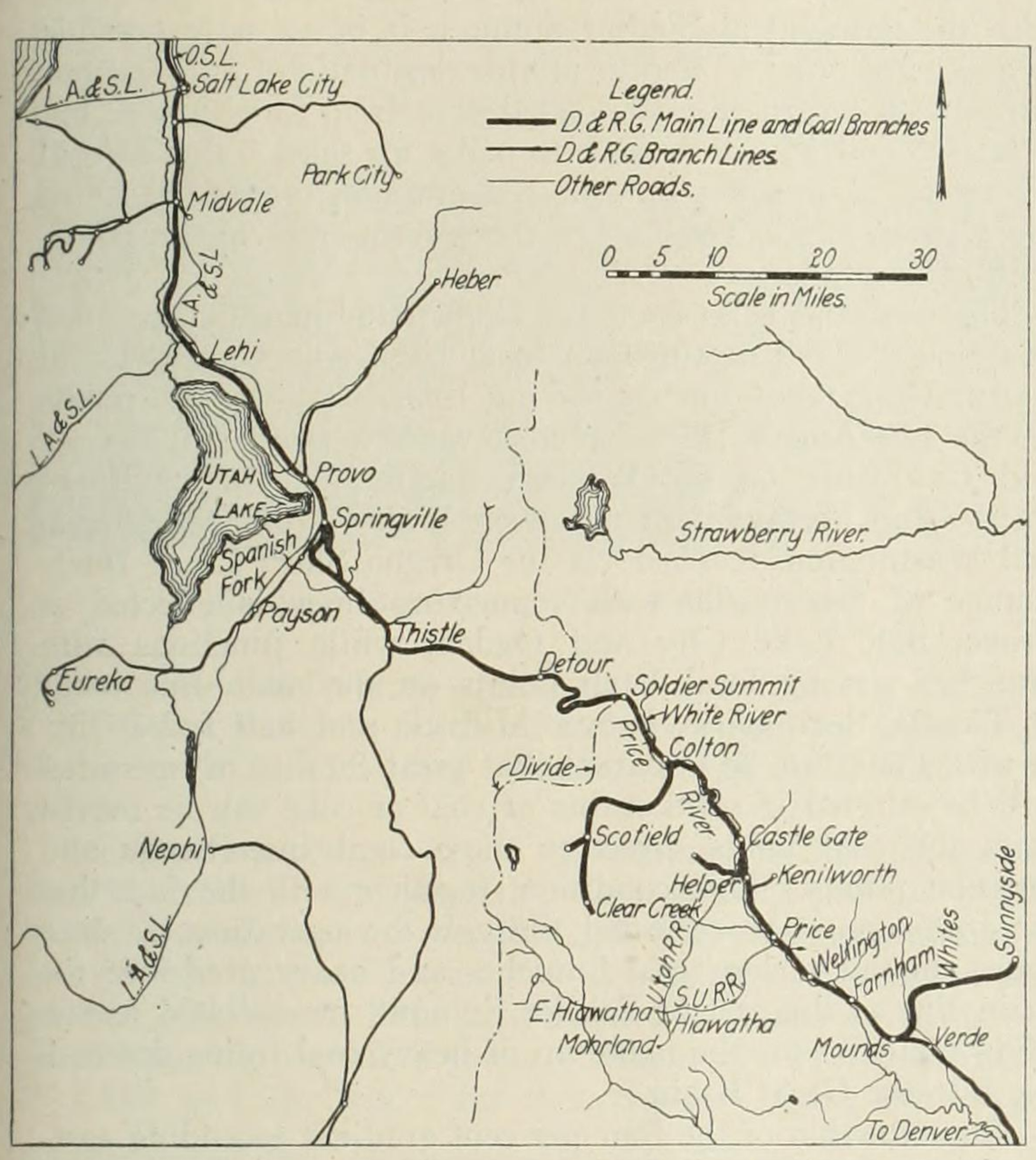
A Terminal Built for Special Operating Conditions

Physical Obstacles Are Also Responsible for Unusual Design of D. & R. G. Yard at Soldier Summit

OF THE OBSTACLES imposed on the Denver & Rio Grande in its efforts to afford adequate transportation for the valuable products of the rugged territory it serves, one of the most formidable is that imposed by the Wahsatch mountains to the coal traffic moving westward into the Great Basin from the Utah coal field. This field, because of the



Relation of the Coal Fields to the D. & R. G. Line Into Salt Lake City

competition of Colorado mines, has of necessity found its market in the Great Basin and areas to the west, southwest and northwest and since the field lies entirely on the east slope of the Wahsatch mountains, the crest of which forms the eastern rim of the Great Basin, all of the coal and coke produced in this region must be lifted over the range to reach its market. With the development of this coal field, the resultant traffic has imposed some interesting operating problems on the Denver & Rio Grande.

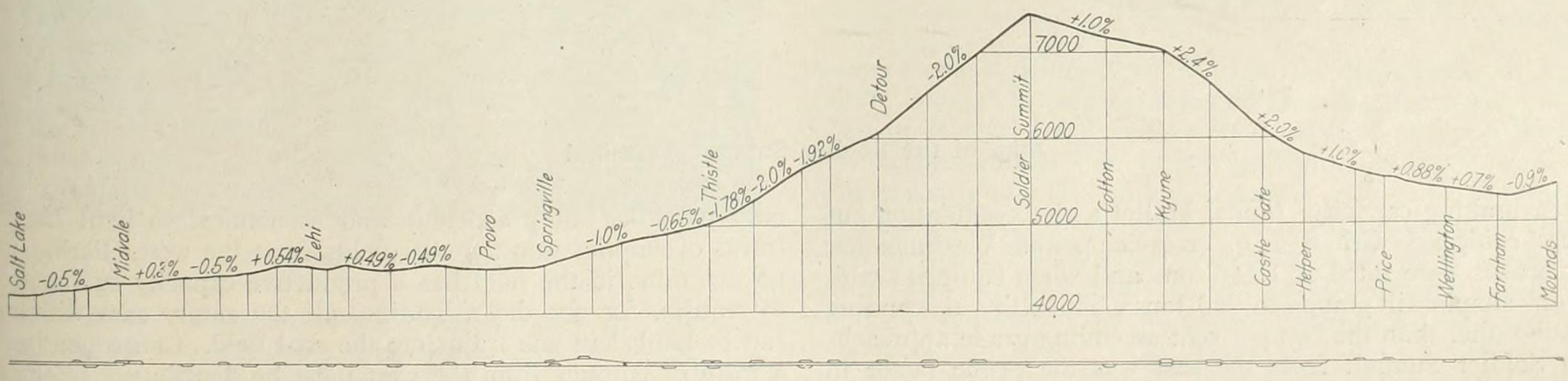
The first important step to expedite transportation on this line, subsequent to its construction in 1883, was the change from narrow to standard gage in 1890. Still more important was the Soldier Summit grade change in 1913 that eliminated the seven miles of four per cent grade which, although on the western or downhill slope, had long imposed a far greater obstacle to the traffic than the 2.4 per cent grade on the east or uphill slope. Experience subsequent to this change demonstrated that the existing operating arrangements did not permit of a full realization of the advantages accruing from this second improvement. As a consequence, a third betterment of this line was undertaken to accomplish a rearrangement of the terminals and engine districts that would best meet the physical conditions and the traffic requirements of the line.

This improvement, which has just been completed, involves the shortening of the first engine district east of Salt Lake City, by moving the terminal from Helper 25 miles up the east slope to the crest of the Wahsatch range at Soldier Summit. This rearrangement of terminals embodies many points of interest not only because of the operating arrangements which made it desirable, but also because of the engineering problems imposed in the placing of an engine terminal and yard in an adverse location.

Physical Characteristics

The physical characteristics of the Utah division of the Denver & Rio Grande are shown in the accompanying map and profile. The mines are all located either on the main line or on branches leaving the main line, between Mounds and Colton. In other words, they are practically all located on the grade rising westward to Soldier Summit. The 13 miles of this line between Helper and Kyune varies from 2 to 2.4 per cent, while the 12 miles just east of the summit, has a maximum of one per cent. From Soldier Summit westward the grades are downhill practically all the way to Salt Lake City, the maximum grade against eastbound traffic being two per cent. There are some minor grades of not over 0.54 per cent against westbound traffic. The line is double tracked from Helper to Provo, 75 miles, and from Midvale to Salt Lake City, about 10 miles.

Some idea of the coal and coke traffic may be obtained from the tables giving the 1916 figures, the last year for which complete data are available. Owing to the increase in coal production since that time the totals cannot be said to be representative of the present conditions except as they indicate a general relative distribution of the output and the relation between eastbound and westbound traffic.



Profile of the Denver & Rio Grande Between Mounds and Salt Lake City

Of specific importance is the fact that the coal and coke

traffic passing westward through Soldier Summit represents about 85 per cent of the total westbound net tonnage and that the total net tonnage westbound is about four times as great as the revenue tonnage eastbound. However, a large part of

Approximate Freight Tonnage Passing Soldier Summit

Calendar Year—1916

Destination—Westbound.

	Coal.	Coke.	Total.
Company coal	400,000		400,000
Other railway locomotives	132,208		132,208
Utah points on other roads	455,957	57,120	513,077
Nevada	202,492	1,456	203,948
California	268,432	16,763	285,195
Idaho	284,441	22	284,463
Montana	19,491	179,098	198,589
Oregon	31,851		31,851
Washington	48,601	325	48,926
Wyoming	100		100
Local Utah points	829,419	153,143	982,562
Total coal and coke	2,672,992	407,927	3,080,919
Other traffic all points West			592,647
Total westbound traffic			3,673,566
*Total eastbound traffic			897,046
Total traffic passing Soldier Summit			4,570,612

* No coal or coke moves east through Soldier Summit.

the eastbound train movement into Soldier Summit consists of the empties returned to the mines, since there are no available empty cars from the east which can be loaded with coal or coke for further westbound movement.

Need for a Change in Operating Arrangements

Prior to the improvement work completed in 1913, the maximum descending grade west from Soldier Summit was four per cent and the length of trains was limited to the tonnage that could be safely handled by the locomotive of given braking capacity. Thus, Mallet and consolidation engines equipped with 8½-in. cross-compound Westinghouse air brakes were rated at 1,150 tons and when equipped with 11-in. simple air pumps to 950 tons. Thus, this descending grade rather than the two per cent ascending grade approaching Soldier Summit from the east was the prime factor in determining the engine ratings, in making up trains from the mines for Salt Lake City.

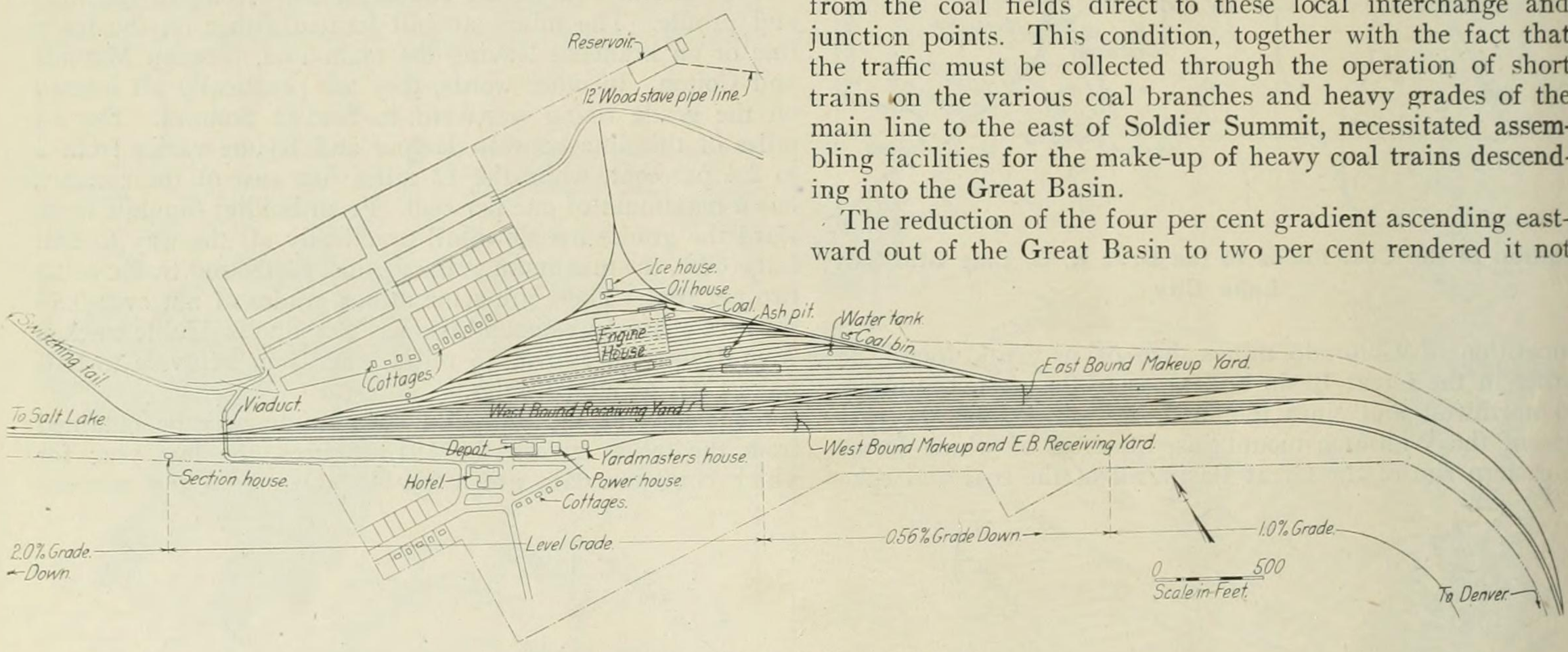
This situation has been entirely changed by the elimination of the four per cent grade since, with a maximum grade of two per cent descending, the limit of tonnage per train is almost entirely removed. It is now practicable to run 65-car trains westward from Soldier Summit and this is a considerably greater train length than it is practicable to operate from the mines to the summit.

When the products of a group of mines is distributed to widely separated markets, economy and efficiency in transportation demand some central point of classification where the loaded cars from the individual mines are grouped according to destination and the empty cars may be equitably and effectively distributed to the mines. Since, as has been pointed out, all the coal and coke originating in this particular field moves to the west, it follows that a point of classification should be west of the most westerly mines. It is a rare coincidence that in this case, Soldier Summit, which is located at the apex of the eastbound and westbound grades, should be just beyond the west edge of the coal fields. Therefore, with the terminal at Soldier Summit, it is not only possible to make up trains of empty cars for destination to the various mines with return runs of loaded cars from these mines, but it is also entirely practicable to make up solid trains of coal destined for certain points of consumption on the tracks of the Denver & Rio Grande, or for certain interchange points with other roads.

The coal and coke from the Utah fields may be classified as follows: That destined for local Utah points in the Great Basin, Utah points on connecting lines, southwestern points on the Los Angeles & Salt Lake, western points in Nevada and California on the Western Pacific and the Southern Pacific and northwestern points in Idaho, Montana, Oregon and Washington, reached via the Oregon Short Line. Interchange of this traffic with connecting lines is effected at Provo, Salt Lake City and Ogden, while junctions with branches serving local Utah points off the main line occur at Thistle, Springville, Provo, Midvale and Salt Lake City. It will, therefore, be apparent that great facility of operation will be effected if solid trains of coal or coke can be moved from the coal fields direct to these local interchange and junction points. This condition, together with the fact that the traffic must be collected through the operation of short trains on the various coal branches and heavy grades of the main line to the east of Soldier Summit, necessitated assembling facilities for the make-up of heavy coal trains descending into the Great Basin.

The reduction of the four per cent gradient ascending eastward out of the Great Basin to two per cent rendered it not only possible, but practicable and economical to haul long trains of empties into the coal fields from the west. Perhaps no one mine in the field has a productive capacity sufficient to require, for one day's loading, all the empty cars which can be hauled in one train into the coal field. Consequently, a train of empties from the west must be distributed among several mines according to the respective productive capacity of each mine.

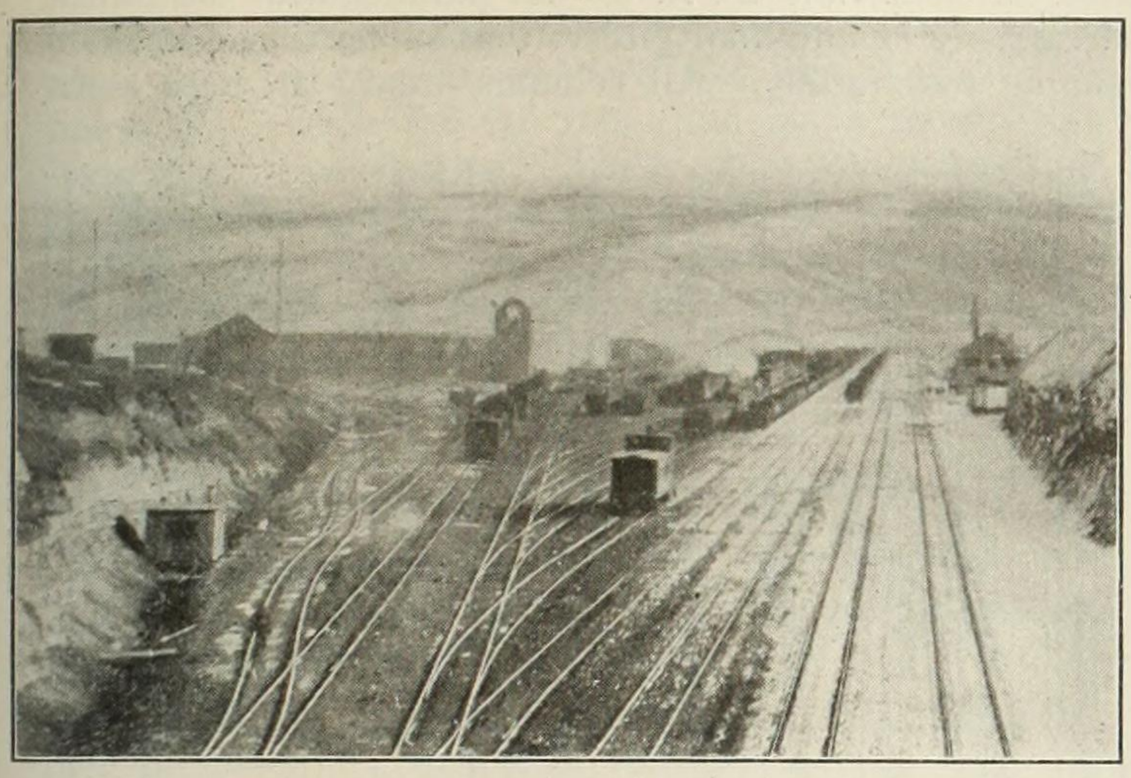
Just as in the case of the assembly of loads for westward movement, so Soldier Summit seemed to be the logical place for the distribution of empties to the various mines. This selection renders it practicable and economical for train and engine crews to serve the mines daily and return with loads to



Map of the Soldier Summit Terminal

the home terminal in the period prescribed by the Hours of Service act.

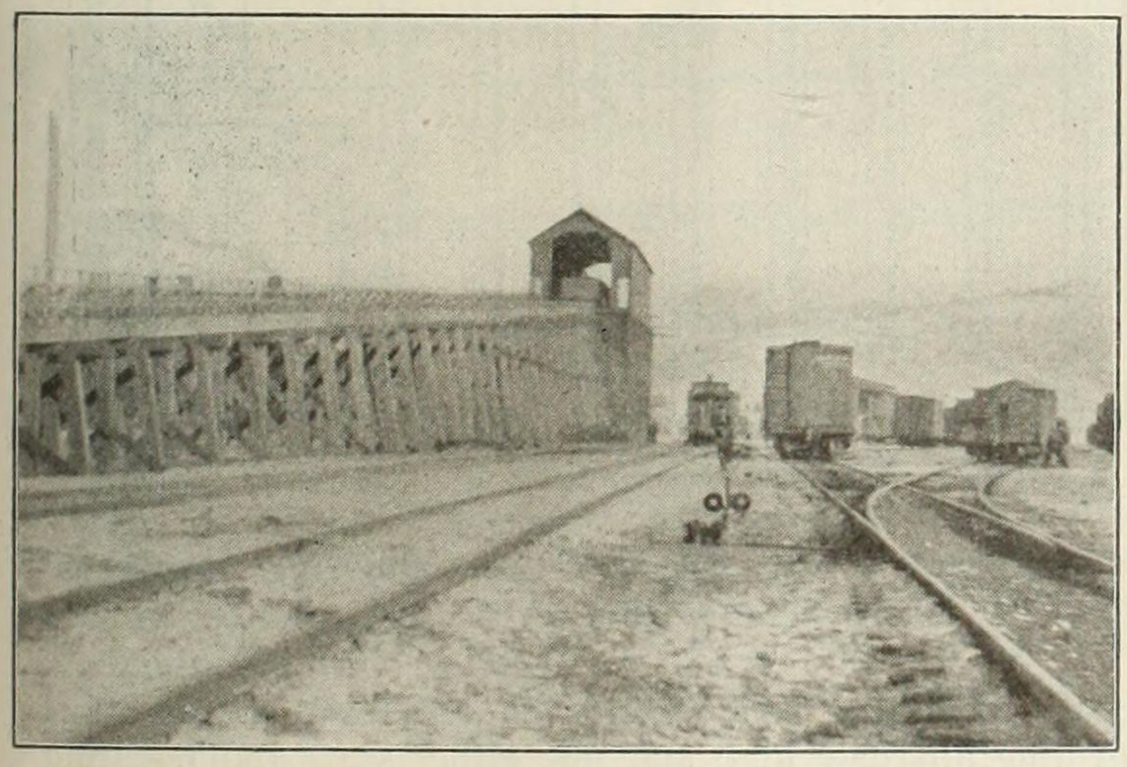
Coupled with the above-mentioned advantages of Soldier Summit as a site for a division terminal, is the very desirable equalization in length of operating districts. The old district, from Green River to Helper, was only 71.3 miles, while the adjoining district, from Helper to Salt Lake City, was 118.6 miles long, and all the mountain grades were on the longer of these two districts. By moving the terminal from Helper 25 miles westward to Soldier Summit the adjacent operating



Looking East from West End of Yard

districts are more nearly equalized as to length, the distance from Green River to Soldier Summit being 96.3 miles and the distance from Soldier Summit to Salt Lake City 93.6 miles.

Another important factor is to be found in the fact that a careful air brake and general train inspection and test must be made on all trains descending either way from the summit. It is decidedly more economical as well as conducive to the greatest efficiency to have such inspections and tests made by the thoroughly organized forces of inspectors with permanent facilities and appliances for the purpose. There is always



The Coal Chute Trestle

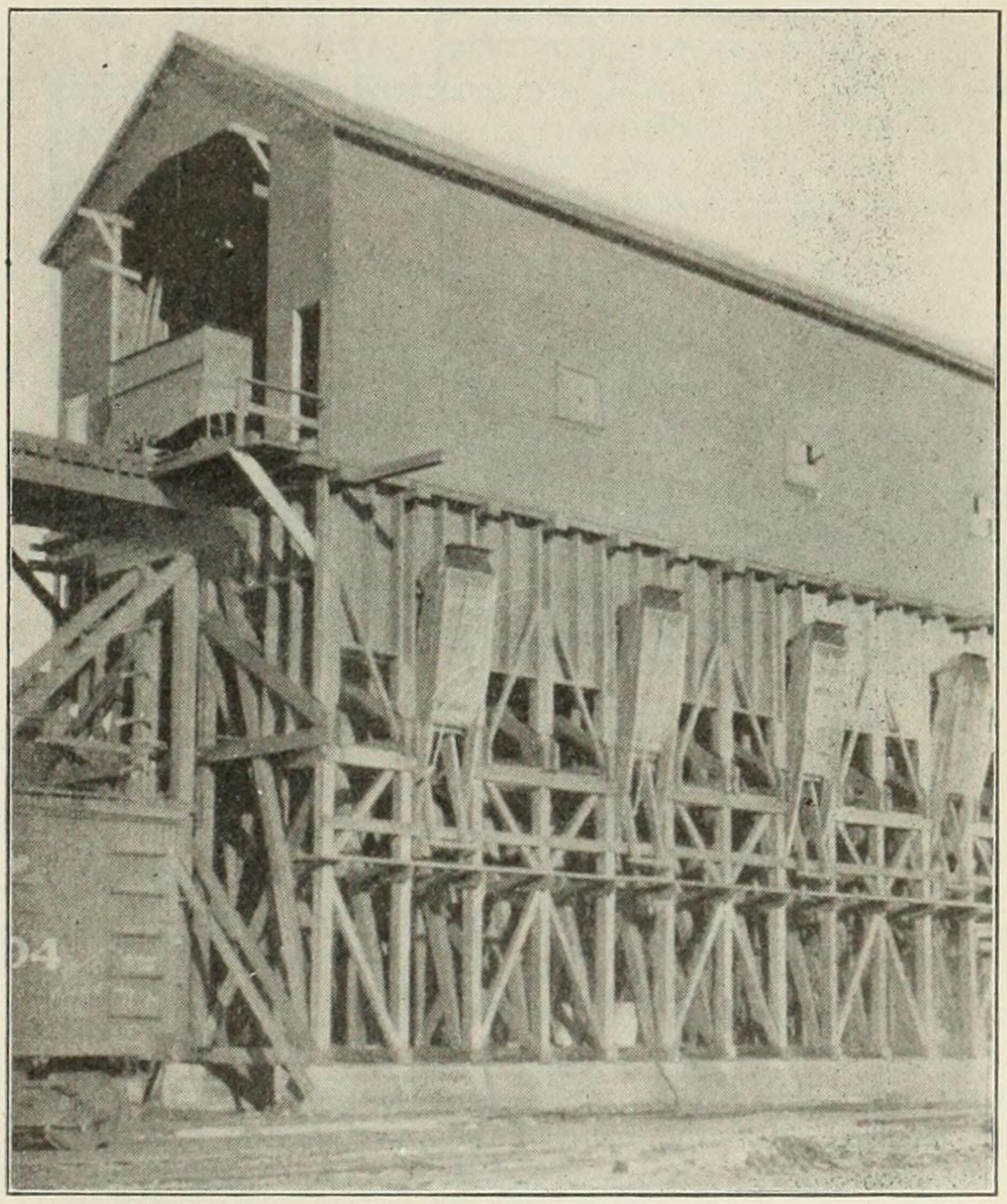
great difficulty in maintaining a competent force and adequate facilities for such purposes at outlying points. Consequently, a division terminal at points where rigid inspections must be made is a distinct advantage.

Requirements of the Terminal

From a consideration of the foregoing statement of the operating conditions, it is seen that the trackage requirements at the division terminal included a receiving yard for long trains of empty cars arriving from the west, a receiving yard for shorter trains of loaded cars arriving from the east, a classification and departure yard for trains of empties eastbound for coal loading and an assembly and departure yard for the long trains of loaded coal cars westbound. The requirements for this purpose under present traffic are for 10 coal trains westbound out of the terminal, 9 empty coal car trains eastbound into the terminal and a larger number of trains of 45 cars or under operating on turn-around runs between the terminal and the mines. A further idea of the requirements of this terminal is indicated by the fact that 31,351 cars were handled through the terminal in the month of December, 1919. Aside from the classification yard, the terminal must furnish complete accommodations for turning engines of which the daily output is 12 Mallet engines and 53 other engines.

Difficult Engineering Problems

The difficulty of locating a classification yard at the apex of grades descending in both directions in mountainous country can well be imagined. Not only was the alinement of



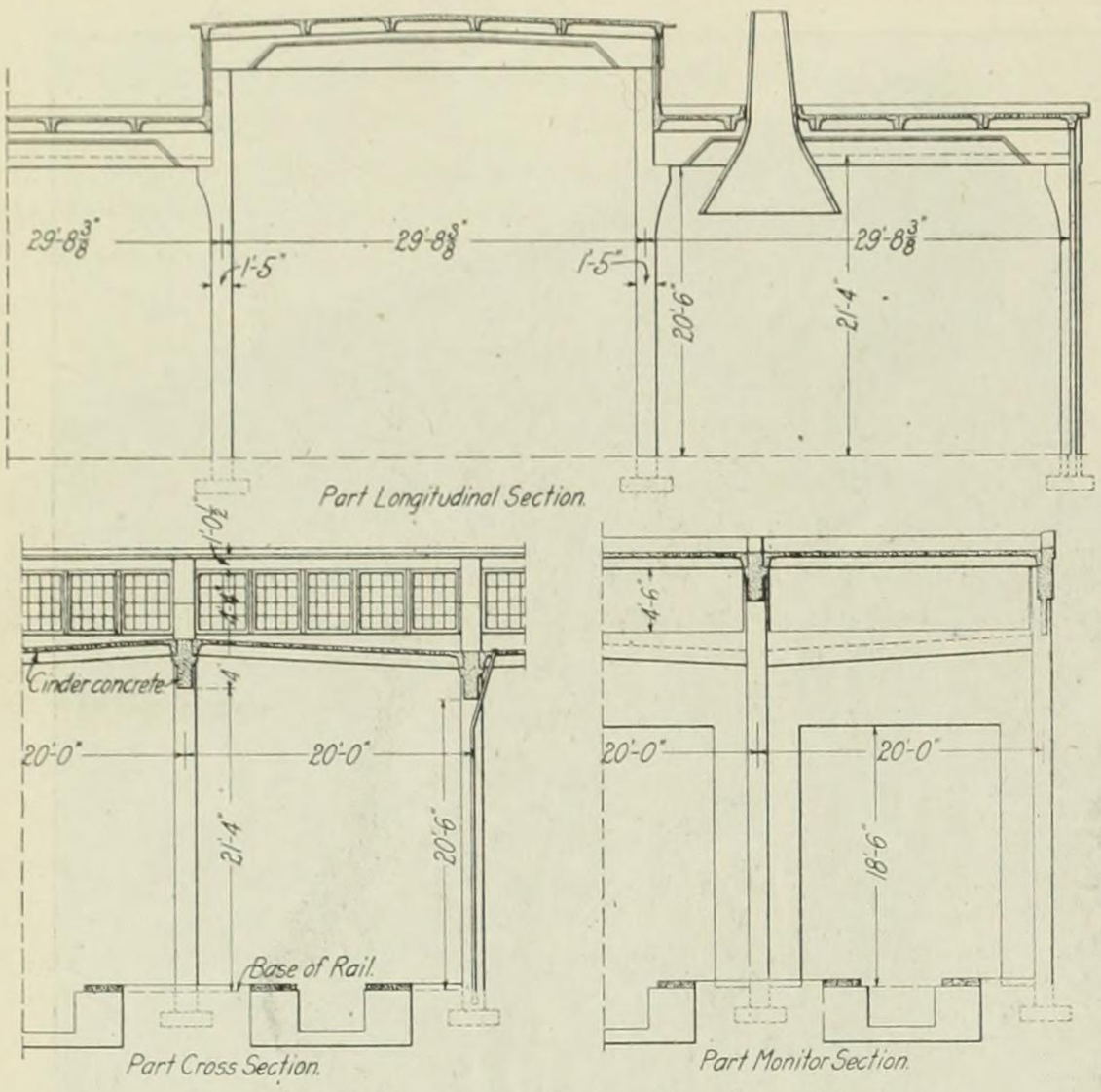
The Coal Chute

the main track, which conformed to the topography of the country, subject to considerable curvature but there was only 2,750 ft. of level track and 1,650 ft. of 0.56 per cent grade between the one-per cent grade descending eastward and a two-per cent grade descending westward. By going to rather extensive grading, it was possible to re-locate the main line so as to secure a tangent for the entire 4,150 ft. of distance between the ends of the two per cent and one per cent grades, but it was impossible to reduce the summit elevation so as to increase this distance. The length of the yard, therefore, was necessarily restricted to these limits which is not any more than the length required for a 100-car train. Under the circumstances, it was impossible to lay out the yard for the conduct of the classification by a progressive movement in the direction of the movement of the traffic. As a consequence, the various units of the yard had to be located in parallel groups within the fixed limits. To secure the desired length at the east end of the yard, the tangent of the yard tracks

was extended considerably beyond the point of curvature of the main track, necessitating main line connections at some distance beyond the end of the yard.

The location of the several yard units in groups side by side necessitated a shuttle movement for the operation of the yard and since this yard arrangement necessarily entailed switching movements beyond the end of the yard proper in either one direction or the other, and since it would have been impracticable to carry on this switching on the heavy main line grade at either end, a switching tail or drill track was constructed from the throat of the yard at the westerly end, supported on a one-per cent ascending grade.

As seen on the map, one grid of tracks is used for the westbound make-up and eastbound receiving yard, while the westbound receiving yard and the eastbound make-up yards comprise two shorted grids, placed end to end. Under the plan of operation short cuts of cars are taken from the receiving tracks and switched into the departure tracks with an eastbound movement which is either on the level or on the 0.56 per cent



Structural Details of the Engine House

down grade. All of the engine house facilities and car repair yards are located to the north of the classification yard.

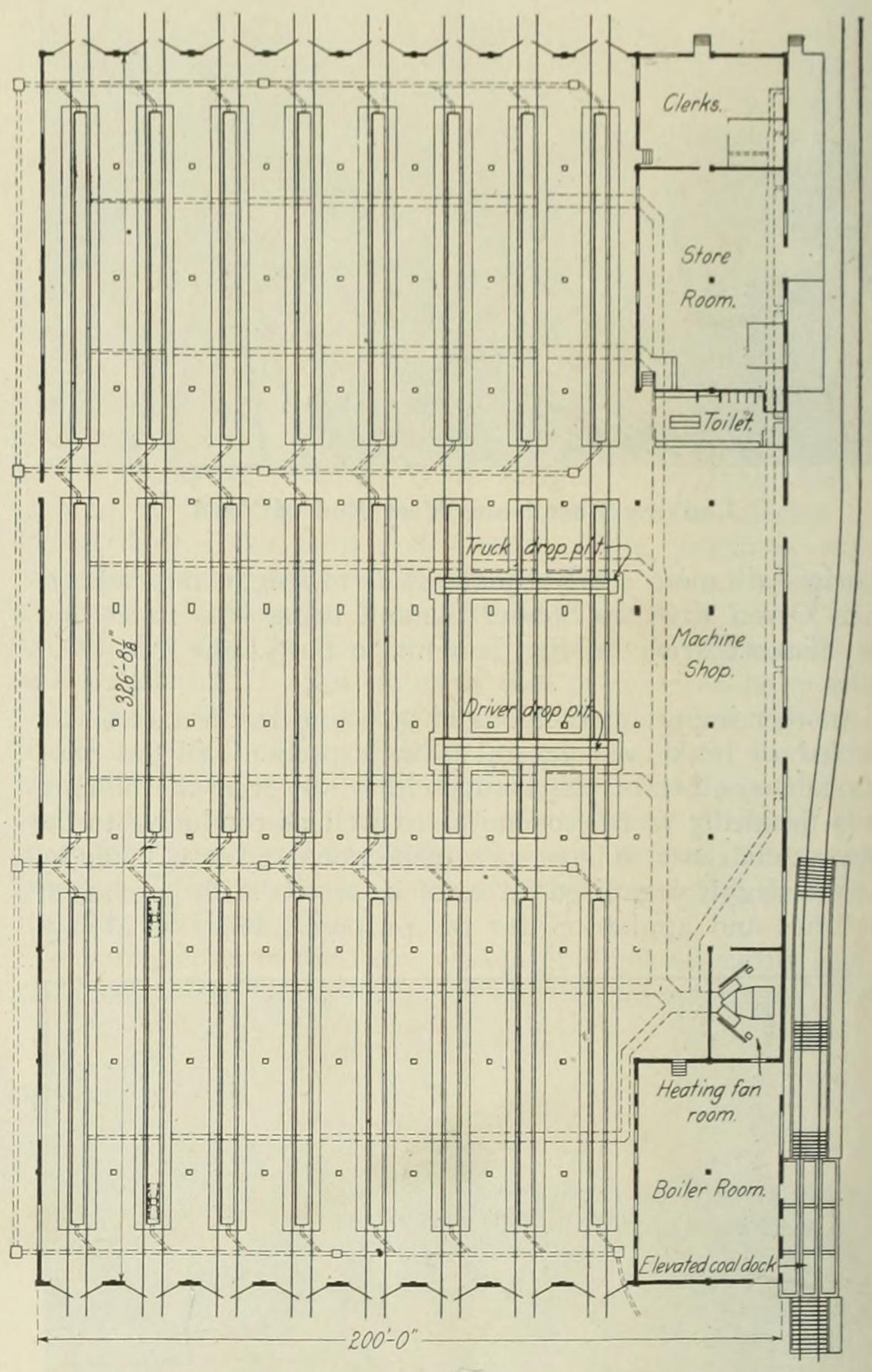
The whole plan of the yard layout was the subject of much study, owing to the heavy expense of grading and to the fact that lowering of summit elevation was out of the question. As finally designed and constructed, the grading quantities amounted to upwards of 460,000 cu. yd. of excavation practically all of which was solid rock.

The Engine Terminal

The distinctive feature of the engine terminal is a rectangular house, an innovation undertaken because of the considerable number of Mallet engines which must be accommodated at this terminal and the difficulty encountered as in all regions subject to heavy snowfall, in keeping the turntable pit clear for operation. The adoption of this type of house was obviously the most important factor in the design of the engine terminal yard. A turning wye was, of course, necessary, and in order to save distance traveled by locomotives in turning, entering and leaving the house, the layout of the house, serving tracks and wye necessarily demanded compactness as a distinguishing feature. The engine house is served by eight through tracks, each of which is equipped with three engine pits, making a total capacity of 24 locomotives. A powerhouse, heating plant and storehouse is also housed under the same roof and the whole is enclosed between the two legs of the wye. The location of the coaling station, the tracks, ash pits and the other auxiliary facilities are clearly indicated on the map.

The Engine House

The house is of the "Unit Bilt" reinforced concrete type, a total of 953 units being used in its construction. The framing consists of columns spaced 20 ft. center to center across the house and 29 ft. 8⅜ in. parallel with the tracks, and carrying longitudinal girders that support concrete slabs spanning transversely. All columns are 27 ft. high above



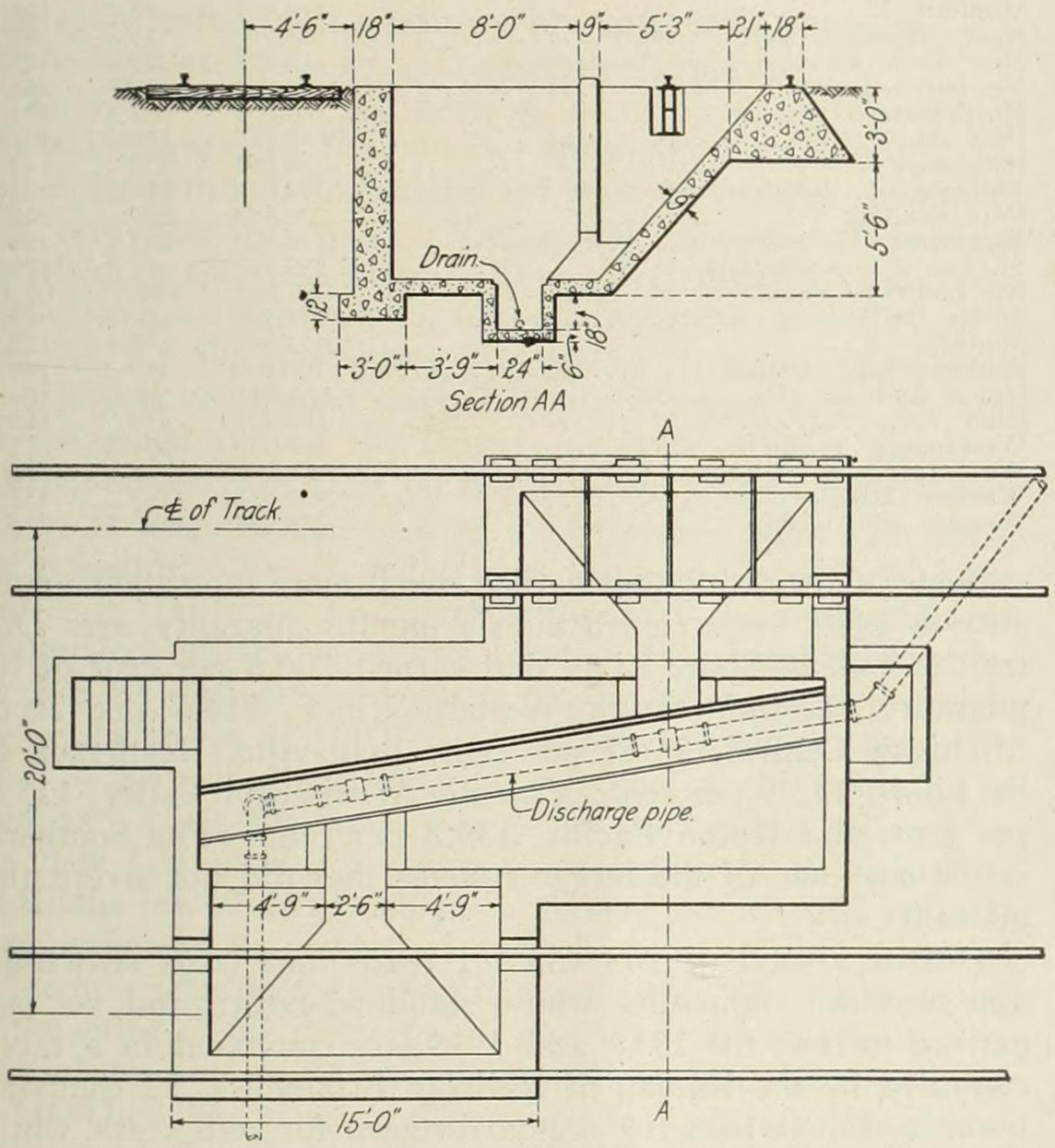
General Plan of the Engine House Showing Layout of Engine Pits

top of rail with corbels on one side 7 ft. from the top, thus providing alternate high and low girder seats and resulting in five high and six low transverse roof bays. The monitors thus formed are fitted with sash, 24 panels of which are pivoted and operated from the floor. The high girders are crowned slightly in the center to provide drainage. The low roof bays have alternate high and low supports, so that the drainage may be collected at low points and conducted by galvanized leader pipes to the engine pits. The entire roof area is covered with two layers of roofing paper and three moppings of hot asphalt pitch. The side walls are formed of slabs with openings for large triple-transom windows and track doors which are double side swing wooden doors affording an opening 14 ft. wide by 18 ft. high.

There are 24 engine pits in the house, three to each of the eight tracks. The pits are 88 ft. in length with walls of mass concrete 3 ft. wide and 3 ft. 10 in. deep, reinforced with heavy triangle wire mesh and provided with rail plates set 24 in., center to center. Screened sumps at the ends lead to vitrified tile drains with concrete manholes at convenient intervals. Concrete drop pits for both drivers and trucks cross three of the engine pits with swinging girder bridges to carry the track rails across the drop pits.

The north 40 ft. of the building is occupied by the master mechanic's office, a storeroom, a machine shop, the heating plant and a boiler room. The floors of the master mechanic's office and storeroom are elevated four feet above the engine house floor, while the fan room and boiler room floors are depressed a like distance. These rooms are enclosed by 13-in. brick walls carried to the under side of the roof girders.

The engine house proper is heated by hot air which is forced through a system of concrete and vitrified pipe ducts from the heating plant as shown on the plan. The air is heated by a group of 64 "Vento" steam radiators, and is then



Plan and Section of the Cinder Pit

forced through the ducts by two motor-driven multi-blade conoidal fans, each of which is of sufficient capacity to deliver 27,000 cu. ft. per min. Low pressure steam coils heat the office and storeroom. Steam for all purposes is furnished by two 200-hp. Murray horizontal water tube boilers. Ashes are discharged to a dump 150 ft. from the boilers through one of the American Steam Conveyor Corporation's special eight-inch cast iron pipe conveyors, operated by a steam jet. A 300-ton capacity coal bin is located in front of boilers and adjacent to the outside wall of building, convenient openings being provided for easy handling of coal.

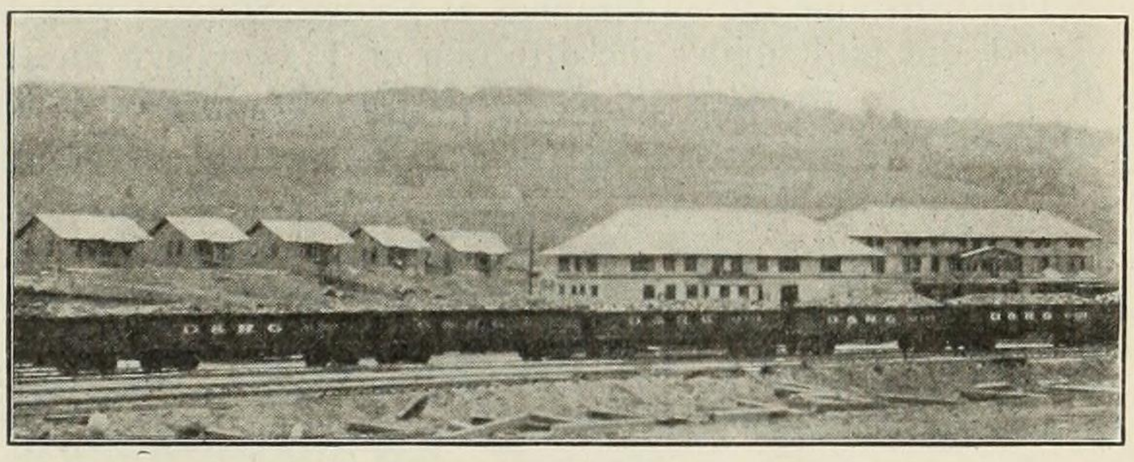
Steam, air and water mains, with laterals for each tier of engine pits, are carried overhead on brackets attached to the concrete columns with drop lines and service connections to serve all pits. A complete boiler washout system equipped with blow-off, wash-out and re-fill pipes and connections was furnished and installed by the Miller Heating Company. Tanks and pressure pumps are located in a separate building just east of the boiler room.

The engine house is lighted by 200-watt lamps suspended from the girders, all vertical and overhead conduits being imbedded in the concrete units. Extension cord sockets are provided in alternate columns.

Auxiliary Facilities

The coal chute is a standard incline wooden structure, provided with 10 coaling pockets, five on each side, having a total capacity of 300 tons. The chute proper is 80 ft. long, supported by 12-in. by 12-in. posts and sills on concrete footings. The incline trestle approach is 528 ft. long, built on a six-per cent grade. A tail trestle extends 80 ft. beyond the chute and under this a wet sand bin was built and supported by the framework of the trestle. The sand drying facilities consist of steam coils, over which the sand passes by gravity to steel drums buried in the ground from which it is forced by air to overhead storage bins.

The layout also includes a double-track concrete cinder pit designed for use with a steam jet pipe conveyor system of disposal. The pit proper is 8 ft. wide, 8 ft. deep and 30 ft. long, built between tracks 20 ft., center to center. This main pit is connected on either side with concrete hoppers, one under each track, which receive the cinders from the locomotive ash pans. A depression in the bottom of the pit contains an eight-inch cast iron conveyor pipe, with intake tees opposite the hoppers. This is carried through one end of the pit and thence underground for a distance of 175 ft. to discharge into the open air. At the opposite end of the pit the conveyor pipe terminates in an overhead line for depositing cinders in cars on an adjacent track. Steam, piped from the stationary boilers a distance of 500 ft. is used at a pressure of 80 to 120 lb. to operate the conveyor system.



Depot, Hotel and Group of Cottages

Because of the prevalence of heavy snow in the winter, a portion of two repair tracks is covered by a frame and corrugated iron structure, 44 ft. wide by 273 ft. long. The oil house is of frame and concrete construction, 26 ft. by 38 ft., with an unloading platform on one side and one end. The superstructure and roof are covered with corrugated galvanized iron. Seven oil storage tanks are located in a concrete cellar 10 ft. deep, while a gasoline tank is buried under the platform outside of the building. A 4-ft. by 4-ft. conduit for oil and heating pipes connects the cellar with the storeroom in the engine house. A complete oil distributing system, consisting of eight automatic self-registering pumps, located in the storeroom, together with fill boxes for barrel and car service and all requisite piping was furnished and installed by the S. F. Bowser Company.

At the summit of heavy grades, the testing of air brakes is particularly necessary, and therefore a brake testing plant with its distributing pipe lines through the yard was installed. Current for all power purposes and the lighting of the terminal is obtained from the Utah Light & Power Company, which has a nearby high voltage electric transmission line.

Water Supply

Another most important engineering problem was the securing of an adequate water supply at a summit location of this character. This requirement was met by the fact that the Denver & Rio Grande held water rights at points along

the Price river. By obtaining authority to transfer the rights to divert water to one of its tributaries, the White river, a normal flow of adequate quantity was secured with an intake of sufficient head above the summit to obtain a gravity flow. This plan necessitated about 3¾ miles of 12-in. wooden stave pipe and a storage reservoir on high ground at the terminal.

Housing Accommodations

Not the least among the features of this project was the provision it was necessary to make for housing the employees and their families, for the surrounding country at Soldier Summit is uninhabited. Ten new six-room and 10 new four-room frame cottages were built for the use of the company employees and in addition a number of cottages from the old terminal at Helper were moved to new locations at Soldier Summit. In addition, a two-story frame hotel building was built in the shape of a "T" 130 ft. across the front and 85 ft. deep. All of the second floor and a part of the first floor is devoted to sleeping rooms and the remainder of the first floor to a lunch room, lobby, kitchen, etc. The map layout of the terminal also shows the location of a two-story frame station building affording space on the second floor for division offices. The hotel and station are heated by a steam-heating plant located in the small structure adjacent to the station. All of the housing buildings, including the employees' cottages, are equipped with modern sanitation for which it was necessary to provide a sewerage disposal system.

The yard and engine terminal at Soldier Summit was designed and built under the direction of J. G. Gwyn and A. O. Ridgway, assistant chief engineer of the Denver & Rio Grande.

Roads That Did Not Accept Six Months Guaranty

WASHINGTON, D. C.

THE LIST MADE public by the Interstate Commerce Commission on March 20 of the 864 companies, including railroads, steamship, bridge, terminal and depot companies, the Pullman Company and American Railway Express Company, that have filed with the commission an acceptance of the provisions of Section 209 of the transportation act, which entitles them to a six-months guaranty by the government but requires them to turn over any earnings in excess of the guaranty to the Treasury, shows that 41 Class I roads and large switching and terminal companies have decided to take their chances without a guaranty, hoping to earn more than the standard return based on the net operating income of the three years ending June 30, 1917. In addition about 100 of the smaller companies, out of the list of roads whose standard return has been certified to the President by the commision as shown by its last annual report, failed to file acceptances of the guaranty and a large number of other short line railroads are missing from the list, but in many cases it is understood that this resulted from a failure to act in time rather than from a deliberate intention to refuse the government's assistance.

According to the law, the acceptances were to be filed by March 15 and the commission on March 4 issued a notice, which was sent to 854 companies by telegraph, suggesting a form of acceptance and of a resolution to be adopted by the boards of directors authorizing the presidents of the various companies to execute the document.

The list of railroads that have accepted the guaranty includes several of the more prosperous companies that earned much more than their standard return in 1918 and 1919 and the list of those that did not accept also includes many that failed to earn their guaranty under federal control.

The Long Island on March 9 filed an acceptance and on March 15 revoked it. The principal companies that have indicated their intention of taking their own chances, together with the amount of the standard return which would have been guaranteed and the percentage of that amount which they earned in 1918 and 1919 is as follows:

	Standard Return	Percentage of Standard Return Earned in	
		1919.	1918.
Alabama Great Southern	$1,703,180	88	121.1
Atlantic & West Point	252,995	213.3	261.1
Atlantic City	222,066	336	458
Belt Railway of Chicago	869,442	186	181
Bessemer & Lake Erie	4,713,564	42.5	104.8
Birmingham Southern	138,815	16.8	223.0
Carolina, Clinchfield & Ohio	1,627,963	92	71.4
Cincinnati, New Orleans & Texas Pacific	3,541,040	14.9	87.3
Colorado & Wyoming	333,053	24.1	57.3
Cumberland Valley	1,228,967	36.4	150.4
Duluth & Iron Range	2,355,242	130.9	162.4
Duluth, Missable & Northern	5,122,051	222.6	244
Duluth, Winnipeg & Pacific	357,136	39	60.9
Elgin, Joliet & Eastern	2,862,177	116.1	167
Fonda, Johnstown & Gloversville	359,583	105	89
Fort Smith & Western	80,499	300	232
Lake Superior & Ishpeming	150,880	187	331
Long Island	3,221,949	75.9	121.5
Louisiana & Arkansas	359,362	(def)	24
Monongahela Connecting	33,620	(def)	416
Montour	314,424	48.2	114
New Orleans & North Eastern	1,204,992	15.5	82.2
New York, Chicago & St. Louis	2,218,857	182.5	175.5
Newburgh & South Shore	75,831	(def)	286
Northwestern Pacific	1 338,000	82.5	111
Pere Marquette	3,748,196	179.2	102.8
Perkiomen	339,091	154	142
Philadelphia, Bethlehem & New England	102,022	(def)	121
Port Reading	236,454	227	208
Richmond, Fredericksburg & Potomac	1,136,974	243.1	266.1
St. Louis Southwestern	3,355,749	91 5	109.7
St. Louis Southwestern of Texas	555,165	(def)	(def)
South Buffalo	141,160	(def)	83.7
Southern	18,653,893	57.1	158.2
Spokane International	190,909	169	140
Union Railroad (Pa.)	1,370,290	30.4	106
Utah	105,425	459	560
Washington Southern	467,230	401.3	371.6
West Jersey & Seashore	952,682	1.3	(def)
Western Pacific	1,900,350	188.2	137.1
Western of Alabama	288,338	197.5	215.8

Some of the roads that earned much more than their guaranty in 1919, yet accepted the six-months guaranty, are: Detroit & Toledo Shore Line, that earned 200.8 per cent of its guaranty; Grand Trunk Western Lines, 214.6 per cent; Michigan Central, 210.7 per cent; Louisville, Henderson & St. Louis, 145.9 per cent; Yazoo & Mississippi Valley, 115.9 per cent, and Union Pacific, 139.8 per cent. The Southern is the only one of the larger systems that did not accept the guaranty.

Out of a total of 203 Class I roads and large switching and terminal companies whose standard return and net operating income for 1918 and 1919 are compared in a table compiled by the Bureau of Railway Economics, 52 companies earned more than the standard return for both years, while 151 companies earned less. The 52 companies earned 33.87 per cent more than their standard return, thereby contributing $110,825,671 toward making up the deficits of the 151 companies that earned 48.2 per cent or $718,676,092 less than their standard return. The 203 roads as a whole earned $607,850,421 or 33.4 per cent less than the standard return.

For 1919 there were 44 roads that earned more than their standard return by 35.8 per cent or $51,784,666, while 159 roads earned less than the standard return by $444,368,818 or 58.1 per cent.

For 1918 there were 76 roads that earned more than the standard return by $85,707,877, or 33.4 per cent, while 127 roads earned less than their standard return by $300,974,146, or 46.15 per cent.

URGES ALASKA LAND DEVELOPMENT.—Legislation to stimulate development of land adjacent to the Alaskan Railroad has been urged by Acting Secretary of the Interior Vogelsang in a letter to the Senate. The department, he said, is without funds to advise farmers and other settlers of opportunities along the railroad, although 1,000,000 acres of agricultural land near the railroad have been surveyed and townsites laid out.